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Workplace Communications Skills and the Value of Communications
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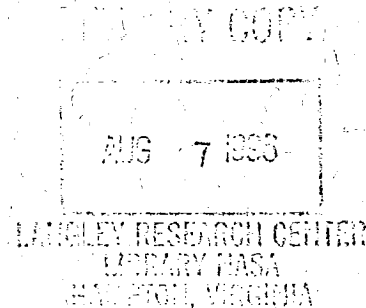
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Abstract

Studies indicate that communications and information-related activities take up a substantial portion of an engineer's work week; therefore, effective communications and information use skills are one of the key engineering competencies that recent graduates of engineering programs are expected to possess. Feedback from industry rates communications and information use skills high in terms of their importance to engineering practice; however, this same feedback rates the communications and information use skills of entry-level engineers low. Missing from current discussions of communications and information use skills and competencies for engineering students is a clear explanation from the professional engineering community about what constitutes "acceptable and desirable communications and information norms" within that community. To gather adequate and generalizable data about communications and information skills instruction and to provide a student perspective on the communications skills of engineers, we undertook a national study of aerospace engineering students in March 1993. The study included questions about the importance of certain communications and information skills to professional success, the instruction students had received in these skills, and perceived helpfulness of the instruction. Selected results from the student study are reported in this paper.

Introduction

Engineers in the work of work report that the communication of information takes up as much as 80% of their time, that the communication of information is an essential element of successful

engineering practice, and that the ability to communicate and use information effectively is critical to professional success and advancement (Mailloux, 1989). Feedback from professional engineers and from engineers' supervisors concerning engineering competencies ranks communications and information use skills—the ability to write effectively, to make oral presentations, and to search out and acquire information—**high** in terms of importance to engineering practice. This same feedback, however, ranks the communications skills of entry-level engineers **low** (Bakos, 1986; Chisman, 1987; Katz, 1993; Kimmel and Monsees, 1979). Although government and industry officials are generally satisfied with the technical knowledge preparation of new hires, they worry about the ability of entry-level engineers to communicate. Kandebo (1988) notes, "if there is a significant problem with entry-level hires, it lies in their lack of training and skill in communication ... a growing number of entry-level engineers cannot write technical reports, fail to make effective presentations of their ideas of concepts, and find it difficult to communicate with peers." Because effective communication and information use is fundamental to engineering and to the professional (career) success of engineers, important questions arise about what communications and information use skills should be taught to engineering students, when those skills should be taught, how much communications and information use instruction is necessary, and how effective current instruction is.

Background

Because communication and information use skills are fundamental to engineering, questions arise of what communications and information use skills should be taught to engineering students and when, how much communications and information use instruction is necessary, and how effective that instruction is. What is missing from any discussion of communications skills instruction for engineering student is (1) a clear explanation from the professional engineering community about what constitutes "acceptable and desirable communications norms" within that community, (2) adequate and generalizable data from engineering students about the communications and information use skills instruction they receive, (3) adequate and generalizable data from entry-level engineers about the adequacy and usefulness of the instruction they received as students, and (4) a mechanism, probably focused within academia, that solicits feedback from the workplace and a system that utilizes the feedback for answering the questions of what and how much should be taught and when, and for determining the effectiveness of instruction.

To contribute to the second question, we surveyed 1,673 student members of the American Institute of Aeronautics and Astronautics (AIAA) in the spring of 1993 (Pinelli, Hecht, Barclay, and Kennedy, 1994). The questions in the student mail (self-reported) survey were assembled around the following topics: (1) the importance of selected communications skills to professional success, the instruction received in these skills, and the helpfulness (usefulness) of that instruction; (2) the use and importance of libraries and other information sources and productions; and (3) the use of computers, selected information technologies, and electronic networks.

Methods and Sample Demographics

Self-administered (self-reported) questionnaires were sent to a sample of 4,300 aerospace engineering students who were (student) members of the AIAA in March 1993. All told, 1,673 AIAA student members returned the questionnaire by the completion date of September 1, 1993. Due to the summer break, only one mailing was possible. After reducing the sample size for incorrect addresses and other mailing problems, the response rate for the survey was 42%. This rate is very acceptable for a student survey with one mailing.

The AIAA has both undergraduate and graduate student members. Most respondents were undergraduates (948 or 55%), although 707 graduate students responded. (We received 70 additional questionnaires in which the respondents did not indicate a class status.) Males (84%) outnumbered females to (16%) approximately five to one. The proportion of females is greater among undergraduates. The gender distribution is very similar (within two percentage points) to the distribution in our earlier survey of senior aerospace engineering students (Holland, Pinelli, Barclay, and Kennedy, 1991). About 93% of the respondents were pursuing a degree in engineering. About 83% of the respondents reported English as their native (first) language. There are substantial differences between the graduate and undergraduate samples in the percentages of students whose native language is not English and who are not native U.S. citizens. Each difference is about 10 percentage points. Over one-fourth of the graduate students are not native U.S. citizens, and almost one-fourth do not consider English their native language (Pinelli, Hecht, Barclay, and Kennedy, 1994).

Presentation of the Data

Engineering is essentially a social and collaborative process that makes observations of the physical world and changes them into products that can be used by others. To carry out these activities, engineers must communicate their ideas and interpretations of their data and findings to others. The ability to produce, use, and acquire technical information effectively thus becomes crucial to the professional success of engineers. This would help explain why employers of engineers and engineers themselves place a high value on technical communications skills.

Workplace Communications and Information Use Skills

A recent article (Evans, Beakley, Crouch, and Yamaguchi, 1993) presented the results of a survey of industry employers and engineering school alumni. Both the employers and the alumni respondents said that technical communications skills were the second most important skills (behind problem-recognition and-solving skills) for engineers to possess. Given a list of eight skills, both groups indicated, however, that engineers were least well-trained in technical communications skills. Among the alumni, technical

communications skills were considered almost as important as engineering core courses. The authors summarize the alumni survey (in part) by stating "that insufficient development of communications skills remains a chronic problem that must be addressed" (Evans, Beakley, Crouch, and Yamaguchi, 1993).

In a *NASA/DoD Aerospace Knowledge Diffusion Research Project* survey that investigated computer-mediated communications (CMC) in aerospace, over 90% of the aerospace engineers surveyed rated skill (ability to) in oral communications very important and about 80% rated skill in written communications very important (Murphy, 1994). Most of the engineering professionals we surveyed indicated that they had taken a course in technical communications (e.g., technical writing), that the course had improved their ability to communicate technical information, and that aerospace engineering students should take a course in technical communications as part of their undergraduate education.

Importance of Technical Communications and Information Use Skills

Student survey participants were given a list of six technical communications and information use skills: (a) technical writing/communication; (b) speech/oral

communication; (c) using a library that contains engineering/science information, resources, and materials; (d) using engineering/science information resources and materials; (e) searching electronic (bibliographic) databases; and (f) using computer, communication, and information technology. Student respondents were asked to indicate the importance of each of these skills to their professional success (table 1). The effective use of computer, communication, and information technology was considered very important by 91% of the students. The effective communication of technical information in writing or orally was rated important by about 84% of the students. Knowledge and understanding of engineering/science information resources and materials was considered important by about 80% of the students. About 64% indicated that knowing how to use a library that contains engineering/science information resources and materials was important to their professional success. Slightly more than half (51%) of the students indicated that the ability to search electronic (bibliographic) data bases was important to their professional success as aerospace engineers.

Skill	Importance		Received		Helpfulness	
	Percentage*	Number	Percentage	Number	Percentage*	Number
Technical Writing/Communication	83.8	1449	72.2	1250	53.7	670
Speech/Oral Communication	83.7	1446	62.2	1076	53.8	587
Using a Library That Contains Engineering/Science Information Resources and Materials	63.9	1101	59.9	1037	39.4	411
Using Engineering/Science Information Resources and Materials	80.3	1382	63.6	1100	44.7	494
Searching Electronic (Bibliographic) Databases	51.4	874	50.2	869	41.3	372
Using Computer, Communication, and Information Technology	90.0	1573	82.9	1433	68.4	968

Table 1. Importance of Communication and Information Use Skills, Skill Instruction Received, and Helpfulness of Instruction for U.S. Aerospace Engineering Students

*The students used a 7-point scale, where 7 includes the highest rating, to evaluate the importance of the skill and the helpfulness of the instruction. The percentages listed in Table 1 are the students who rate the importance of the skill or helpfulness of the instruction as either a "6" or "7".

Receipt of Technical Communications and Information Use Instruction/ Training

Next, we asked the students to indicate if they had received instruction/training in the six communications and information use skills and to rate the perceived helpfulness (usefulness) of that instruction (table 1). Half or more of the students had received some form of instruction/training in the six skills. About 83% and 72% of the students had received some form of instruction/training in using computer, communication, and information technology and technical writing/communications, respectively. About 50% received some form of instruction/training in searching electronic (bibliographic) data bases.

Helpfulness of Technical Communications and Information Use Instruction/Training

Even if engineering and technical communications educators provide access to the instruction/training and a substantial portion of the students avail themselves of the opportunity, the students still may not perceive the instruction/training to be helpful, however. In fact, the students' perceptions of the helpfulness (usefulness) of the instruction/training varied. Of those who had received instruction/training in using computer, communication, and information technology, about two-thirds found it helpful (useful). About 54% of those student respondents who had received instruction/training in technical writing/communications and speech/oral communications perceived it to be helpful (useful).

Concluding Remarks

The literature we reviewed suggests that, in general, entry-level engineers lack the communications and information use skills to write effectively, make oral presentations, and search out and acquire information, the very skills that the literature indicates are needed for a successful engineering career. In the absence of an explanation from the professional engineering community about what constitutes acceptable and desirable communications norms, and given the lack of adequate and generalizable data that would demonstrate the communications and information use skills of entry-level engineers, we will assume that entry-level engineers may not be skilled communicators. Three possible explanations may account for their lack of skill: (1) they are not receiving communications and

information use skill instruction/training as part of their academic preparation; (2) the communications and information use skill instruction/training they receive as part of their academic preparation is not helpful; and (3) the communications and information use skill instruction/training they receive as part of their academic preparation is inappropriate for the workplace; that is, there is a "disconnect" between academic perceptions of workplace communications and the realities of workplace communications.

Although the findings of our study have provided some insights about the communication and information use skill instruction of aerospace engineering students, we have raised more questions than we have answered. We suggest the following. Conduct a series of coordinated studies designed to obtain adequate and generalizable data about the communications skills instruction that students in various engineering disciplines receive as part of their academic preparation. Undertake a study of entry-level engineers across engineering disciplines to determine what kinds of communications they produce and what skills they use to produce them. Collect adequate and generalizable data from entry-level engineers across engineering disciplines about the adequacy and usefulness of the communications skills instruction they received as students. Finally, determine from among the professional engineering community what constitutes acceptable and desirable communications norms in light of the persistent complaint that entry-level engineers lack the communications skills needed for professional success. Increased knowledge of the communications environment and workplace culture could help academic technical communicators improve instruction.

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